



**US Army Corps
of Engineers®**
Cold Regions Research &
Engineering Laboratory

Ice Engineering

U.S. Army Engineer Research and Development Center, Hanover, New Hampshire

Ice Jams, Winter 2002–2003

Ice jams are accumulations of ice in rivers, lakes, and streams (Fig. 1) that can cause destructive floods upstream that are costly to surrounding communities. Areas downstream from the jam also can be affected if the jam releases suddenly, sending a surge of water and ice downstream. The rapid changes in water levels associated with jams often leave little time to prepare for flooding. Damages caused by ice jams can be extensive, affecting roads, bridges, buildings, and homes. Emergency aid and evacuation during ice jam flooding can be delayed or limited because roads and runways may be forced to close and bridges damaged or destroyed. Disruption of commerce on ice-jammed rivers can temporarily halt transportation of heating fuel and other necessary cargo.

Ice movement also affects the environment and can cause severe erosion of riverbeds and banks. Wildlife, fish habitat, and vegetation can be adversely affected by ice. It has been estimated that ice jam damages have cost the United States more than \$100 million annually.

Engineers at the U.S. Army Engineer Research and Development Center's Cold Regions Research and Engineering Laboratory (ERDC-CRREL) have been working to develop and optimize low-cost structural and nonstructural techniques, such as early warning systems, ice dusting, ice breaking, ice weakening, and ice jam removal techniques, to prevent or alleviate damages caused by ice jams. Methods of predicting ice jam occurrence and severity are also being developed.

These efforts rely on data included in ERDC-CRREL's Ice Jam Database (White 1996). Currently there are over 14,100 entries in the database, with the earliest occurring in 1780. ERDC-CRREL's database is a reliable resource used to research previous ice jams and to assess specific situations that may cause ice jam formation. Each entry includes river name, location, U.S. Geological Survey (USGS) hydrologic unit code, USGS gage number (if available), jam type and date (if known), local and ERDC-CRREL contacts, a summary of the event, and a list of publications on the jam. The database also can serve as a source of documented responses from engineers and officials who helped relieve the emergency situations.

This issue provides a brief summary of ice jam data for water year (WY) 2003 (1 October 2002 through 30 September 2003) collected in the ERDC-CRREL Ice Jam Database. There are 137 entries in the database for this year. A substantial amount of the information on ice jams in 2003 came from National Weather Service Bulletins. Other sources include ERDC-CRREL contacts, the USGS, and Internet sites.

When Did Ice Jams Occur in 2002–2003?

During WY 2003, ice events most frequently occurred in the month of March, accounting for 46% of the total ice events. February was the second most common month, with 22% of ice jams, most occurring between the second and 27th. January had a total of 14%, while the months of December, April, May, and November all had less than 20% combined (Fig. 2).



Figure 1. Ice jam on the Saint John River at Dickey, Maine, on 17 April 2003. Photo courtesy of Mark Turner, NWS.

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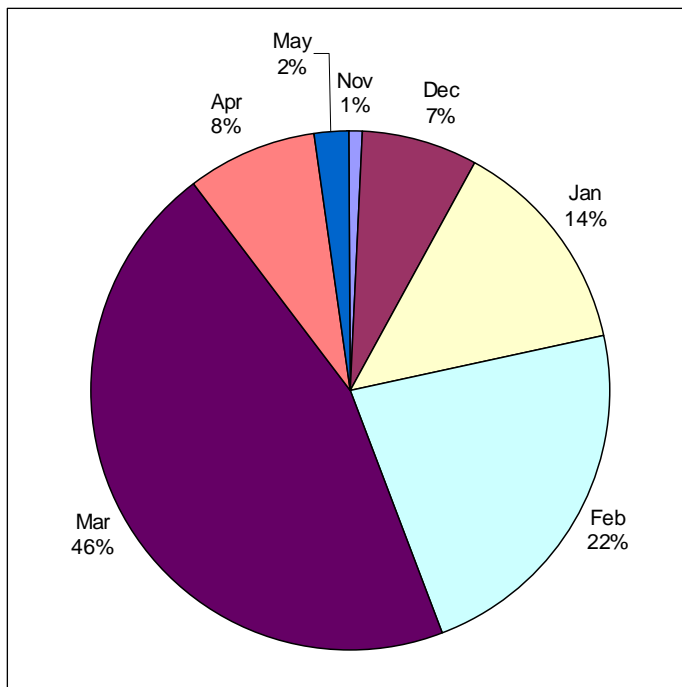


Figure 2. Months in which ice jams were most frequently reported in WY 2003.

22 events happened between the 16th and 26th of the month. Flooding of roads, yards, fields, cellars, and low areas were reported in seven of the events.

Eight of Pennsylvania's jams were on the Allegheny River, which had the most reported jams in 2003. Tied for second, with seven events each, were the Mohawk River in New York and the Aroostook River in Maine. The St. John River in Maine came in third with six ice jams reported, while the Yellowstone River in Montana reported five jams (Fig. 4b).

Allegheny River, Pennsylvania

Five of the eight ice events on the Allegheny River were freezeup jams occurring in January. On 21 January, the National Weather Service reported a long freezeup jam on the Allegheny River that extended from Tionesta to nine miles upstream, with the ice 4 to 6 feet thick at the base of the jam (NWS 2003b, c). On the same day, Oil City had a two-mile-long freezeup jam. Another freezeup jam, reported on 24 January, extended from Brady's Bend up the Allegheny River about five miles to Hillville. This large freezeup jam was still in place on 28 January (NWS 2003d). Again on 28 January, another freezeup jam was reported from Reno north for two miles (NWS 2003e).

Cattaraugus Creek, New York

On 7 March 2003, Larry Sherman from the Buffalo District Corps of Engineers, NYSDEC, and the Town of Hanover, New York, met to discuss pros and cons of breaking up the river/lake ice at Sunset Bay (Irving), New York. The confluence of Cattaraugus Creek and Lake Erie at Sunset Bay is the site of frequent ice jams. By early March, the ice on Cattaraugus Creek was between 2 and 2.5 feet thick and the ice on the lake was reported to be 4 feet thick off of Cattaraugus Creek.

Ten days later, a breakup ice jam occurred at Sunset Bay. On 18 March water had backed up as a result of the jammed ice (NWS 2003f). The ice had moved out to the lake, leaving behind mud and ice debris. Because many of the homes in Sunset Bay are elevated, the damage was limited. However, a *Buffalo News* article on 19 March 2003 (Thomas 2003) reported that in Hanover, "Roughly 400 people from 200 homes were evacuated Monday night." The *Buffalo News* also mentioned that Steven D'Angelo (Town of Hanover disaster coordinator) "estimated that 30 homes had 50 percent damage or more." Most of the damage was limited to vast amounts of mud, and some homes had water in their garages and basements (Ploetz and Warner 2003) (Fig. 5).

Both 1998 and 2001 had a fairly similar monthly jam distribution, with 30% of ice jams in March and 11% in February.

March 2003 had a total of 63 ice events, with 22 of those ice events occurring in New York State. March's ice jams occurred almost every day between the fifth and the 26th, with seven jams reported on the 18th and eight jams reported on the 21st.

Where Did Ice Jams Occur in 2002–2003?

Ice jams were reported in 17 states during WY 2003 (Fig. 4a). New York had 35 reported ice jams, more than any other state. Maine had 28 ice jams; Pennsylvania, Ohio, and Alaska had 19, 12, and 10 events, respectively. All other states had four or fewer events (Fig. 3).

The combination of runoff and above-freezing temperatures led to a few ice jams around the New York region on 23 February. Hydrographs indicated that ice moved and jammed on the following watersheds: Buffalo Creek at Gardenville, Cazenovia Creek at Ebenezer, Cattaraugus Creek at Gowanda, Rondout Creek at Rosendale, and Walkill River at Gardiner (NWS 2003a).

Twenty-two of New York's jams occurred in March when ice covers broke up in the rivers. Eighteen of these

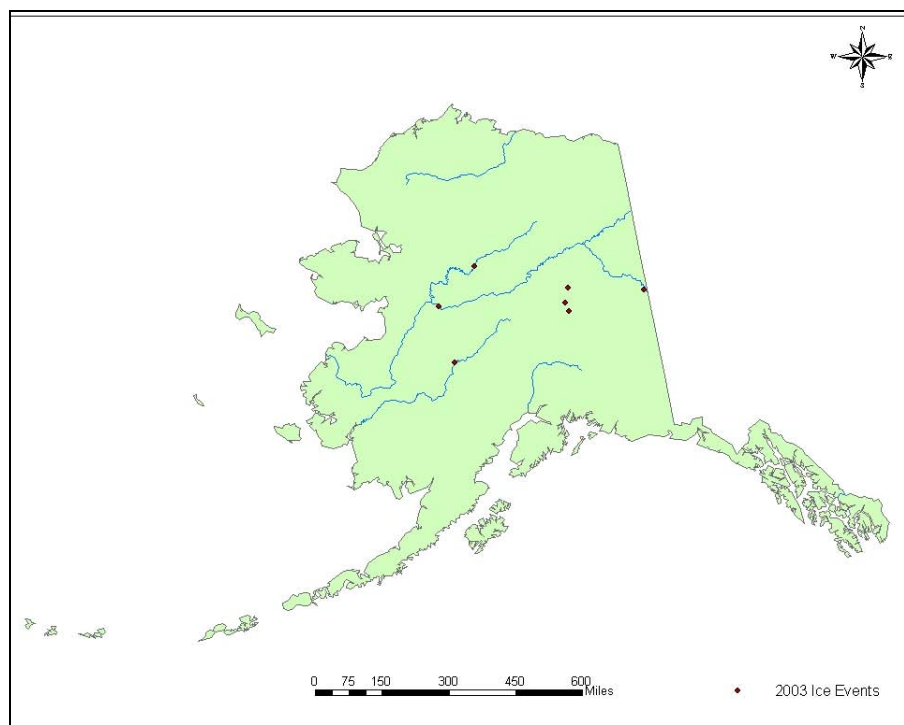
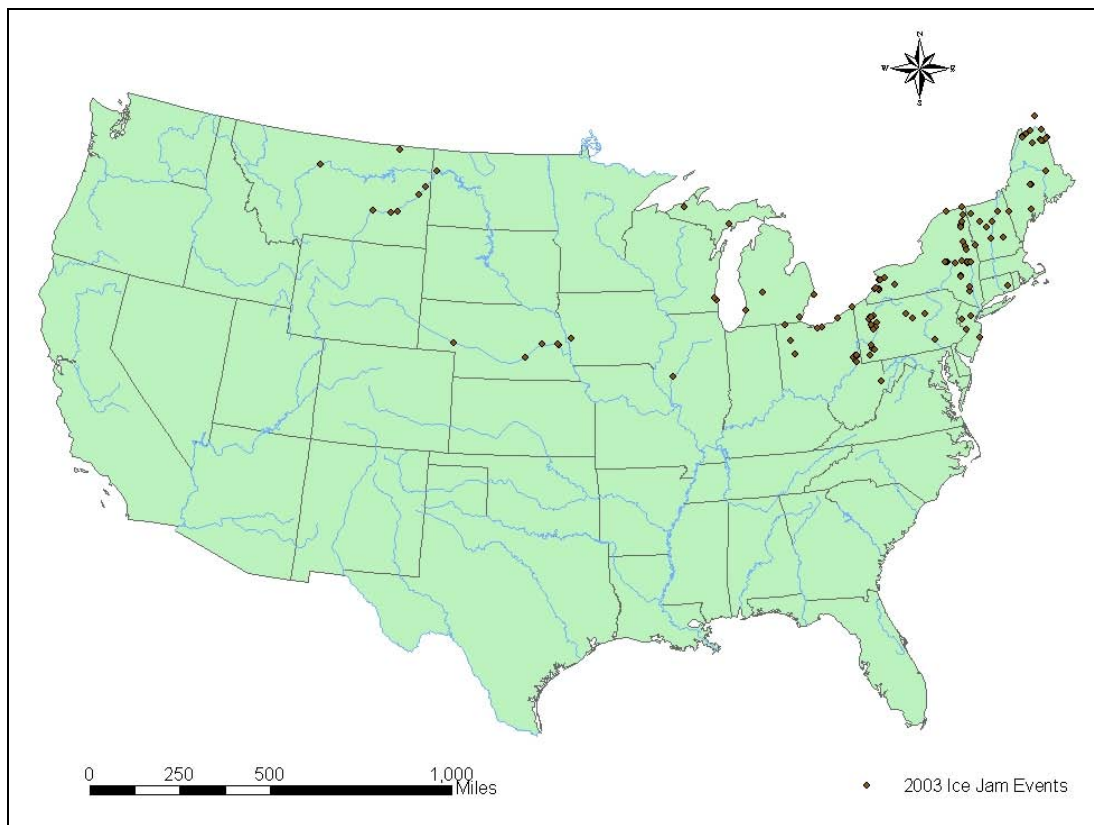
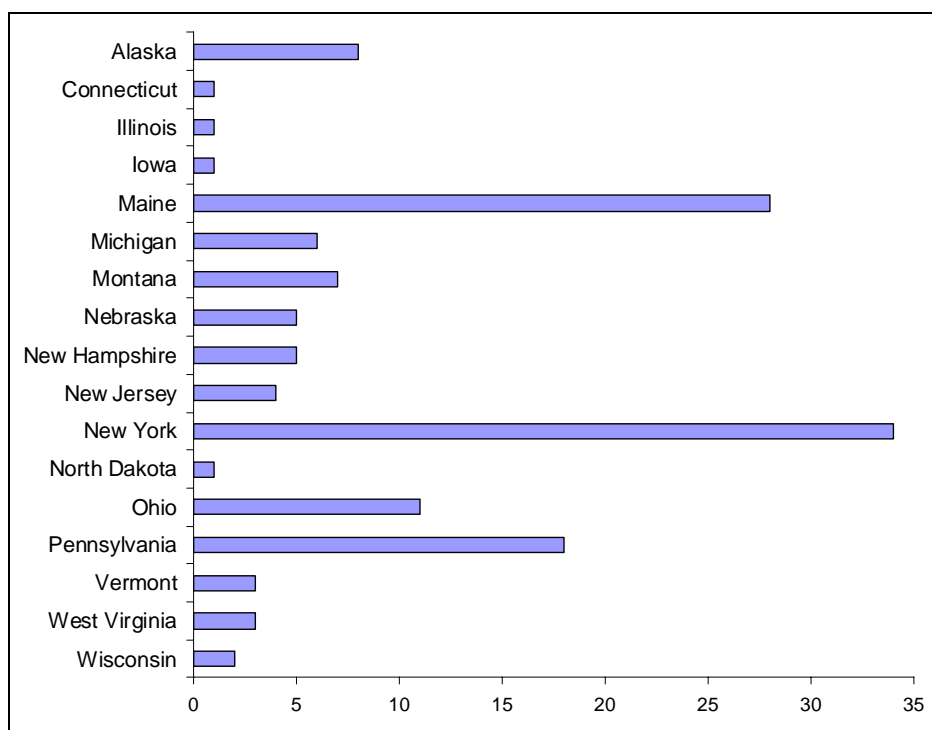
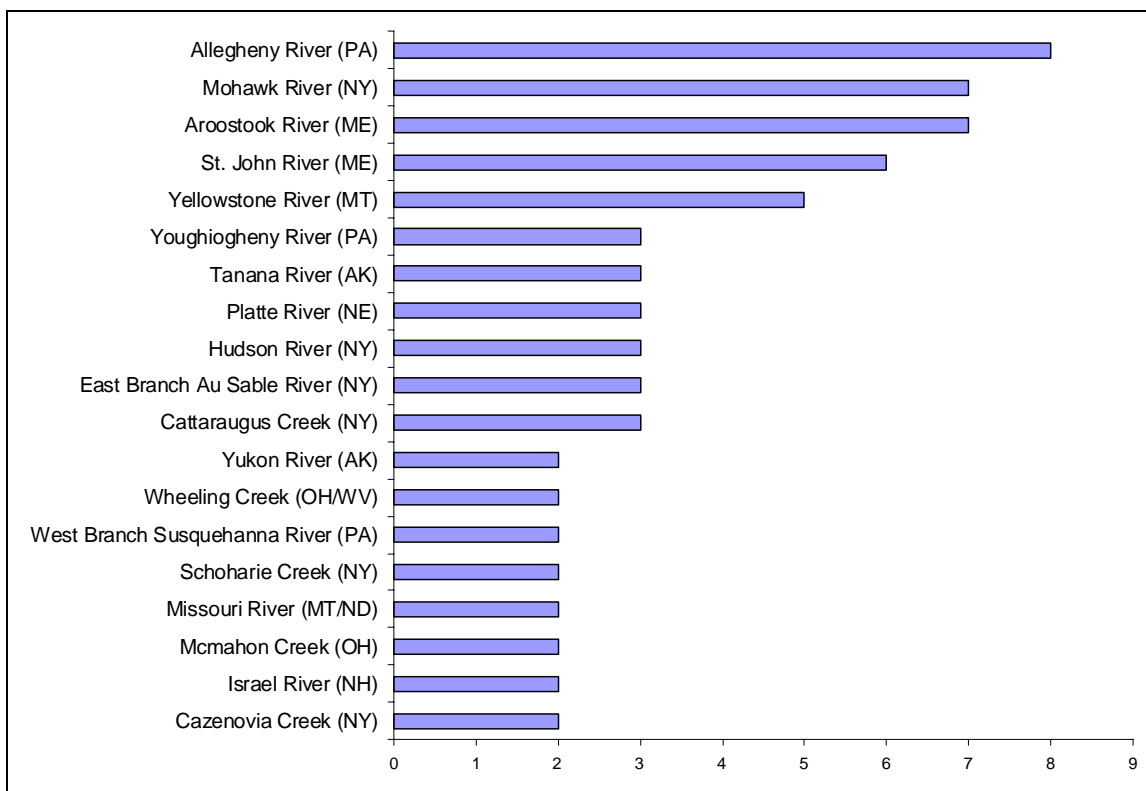


Figure 3. Map of United States and Alaska showing events for WY 2003.



a. States where ice jams most frequently occurred during WY 2003.



b. Rivers where ice jams most frequently occurred during WY 2003.

Figure 4. Most frequent occurrences of ice jams during WY 2003.

Cazenovia Creek, New York

Cazenovia Creek at West Seneca is no stranger to ice jam flooding. The first recorded ice jam at West Seneca in ERDC-CRREL's Ice Jam database is dated February 1904. In March 1955, damages of \$147K (1955 USD) were reported when flooding occurred after 2.4 inches of rain fell in six hours over frozen ground. Gage records say all stages were affected by ice jams.

In March 1956, 2.1 inches of rain fell, resulting in discharge of about 13,000 cubic feet per second at the Ebenezer gage; flooding damages were \$84K (1956 USD). In January 1959, rainfall on the 20th and 21st fell on nine-inch snowpack, combined with warm temperatures, and caused heavy runoff. The January 1959 event resulted in higher water levels (even though lower discharge) than March 1955 or March 1956. Levees were built as a result of this flood. The resulting cost was 86K in damages (1959 USD) (Buffalo District 1966).

Levees built after the January 1959 event prevented about \$195K in damages during a breakup jam that occurred in January 1962. In the 1960s, blasting was used to relieve flooding caused by ice jams in the upper reaches of Cazenovia Creek (Buffalo District 1966, Rock Island District 1967).

In February 1970, flooding resulted in damages of \$70K (1970 USD). The Buffalo District Situation Report (1972) referred to a 1.5-mile-long jam that caused flooding on 28–29 January, with preliminary damage estimates of \$15K, followed by receding waters. The jam stayed in place, however, and caused additional flooding on 2–3 February. One hundred people were evacuated; flooding peaked at 0100 hours and had receded one foot by 0800 hours. At the time, damages were estimated about equal to the January 1959 event (Buffalo District 1975).

Cazenovia Creek continues to experience ice jam flooding to this day. On 16 March 2003, ice broke up rapidly on the upper reaches of Cazenovia Creek (Fig. 6). A large ice flow moved downstream from West Seneca, New York (NWS 2003g) (Fig. 7). That night some Willowdale residents were evacuated from their homes (Gustek and Koralewski 2003). On 17 March, officials reported three ice jams in place along Cazenovia Creek. The ice cover had settled down and jammed on the creek from the Buffalo River through the City of Buffalo flood control project to Cazenovia Road. Another jam extended from about 2000 feet upstream of Mill Road to just past Transit Road. However, this jam failed, moving downstream to jam at yet a third jam located between the railroad bridge downstream of Ridge Road and the soccer fields downstream of Parkside Drive. The resulting water level was high enough for water to pour over part of the levee surrounding the Parkside Drive area of West Seneca.

On 18 March, high water from the previous night flowed over the levee on Parkside Drive (Gustek and Koralewski 2003). Evidence of the high water that flowed over the levee was visible in the mud on Parkside Drive, pumps pumping water out of basements, sandbags around some houses, and mud over the levee where the water overtopped it (Sherman and Koralewski 2003).

On 19 March 2003, the Town of West Seneca reported that Cazenovia Creek was now ice-free as far as the Buffalo River.

St. John and Aroostook Rivers, Maine

Most of the ice events in Maine occurred during four time periods: 17 December, 24–30 March, and 5 and 20 April. Events during December and April occurred on the St. John and Aroostook Rivers, while the March events were scattered on several different rivers. The jams reported in December were freezeup jams and those reported in April were breakup jams, as expected.



Figure 5. An ice jam in March on the Cazenovia Creek at Sunset Bay, New York, left behind mud piles (top) and ice debris (bottom). Photos courtesy of Larry Sherman, CELRB.



Figure 6. Cazenovia Creek at West Seneca, New York, is no stranger to ice jam flooding. Events such as the one pictured above, which occurred on 16 March 2003, have caused up to \$195K in damages in the past. (Left) Right bank of the Cazenovia Street Bridge. (Right) Looking downstream towards Cazenovia Street Bridge. Photos courtesy of Larry Sherman, CELRB.



Figure 7. Looking upstream at the Cazenovia Creek ice jam at West Seneca, New York, from Leydecker Road, on 17 March 2003. Photo courtesy of Keith Koralewski, CELRB.

The St. John River had six ice events, five of them breakup jams occurring in April. The most significant ice jam was located between the towns of Allagash and Dickey. This jam extended well back through the northern Maine woods, extending approximately four miles and covering the width of the St. John River. The jam was locked in place as a result of cold temperatures. At 1100 on 5 April, the gage reading at Dickey was 20.78 feet compared to a flood stage of 25 feet. Open water with ice breaking up was noted just south of the jam through the town of Allagash straight into Fort Kent (NWS 2003h) (Fig. 8).

On the Aroostook River, seven events were reported for water year 2003. The most notable jams were located between Caribou and Fort Fairfield, and from Presque Isle and Washburn (NWS 2003i). Of the seven, four were reported in December and three in April. On 17 December 2002, a freezeup jam was located in the bend of the Aroostook River about two miles north of the bridge in Fort Fairfield, Maine. The freezeup jam (located on the Aroostook River, downstream of the village of

Crouseville on State Route 164 between the towns of Washburn and Presque Isle) was estimated to be one-quarter of a mile long in December. This jam remained in place until 21 April 2003, then appeared to break in half, sending the downstream floe of ice southeast through the town of Presque Isle while the most upstream section of the jam remained lodged among the islands of the Aroostook River near Crouseville. This jam caused the river to back up into low lying areas of the flood plane (NWS 2003j).

Corps of Engineers Response

During the 2002–2003 ice jam season, ERDC-CRREL provided technical assistance to communities affected by ice jams and subsequent flooding. ERDC-CRREL provided recommendations, referrals, on-site observations, and points of contact to the Corps of Engineers New England Division and of other regions.



Figure 8. Looking across the St. John River from the gage at Dickey, Maine. Photo courtesy of Mark Turner, NWS.

How Is This Information Helpful?

This overview of WY 2003 ice jams is the seventh entry in a series of yearly ice jam summaries. The Ice Jam Database is updated annually to provide an accurate summary of the previous water year ice events, including date of occurrence, location, damages incurred, and Corps response. This historical information can be crucial to officials in emergency situations. Weather patterns, frequent jamming locations, water stage, flooded areas, and mitigation techniques are all pertinent factors when trying to predict ice jams and prevent potential damages. Knowing what situations caused jamming and to what extent can help prepare a community for the effects of the jam.

ERDC-CRREL also has an Ice Jam Archive containing hard copies of the information used in annual reports. Information sources include NWS reports, newspaper articles, and other reports that have been used as sources of information for the Ice Jam Database since before WY 1996. These reports can be checked out or photocopied for research purposes.

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Ice Engineering

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